

Summaries

UDC 541.791.02.238

**Lazarchuk V.V., Shikerun T.G., Ryabov A.S.,
Shamin V.I., Zhiganov A.N.**
**PERSPECTIVES OF SIBERIAN CHEMICAL PLANT
IN INCREASING VOLUMES OF URANIUM
CONCENTRATES RECYCLING**

The purification technology of uranium concentrate of natural isotopic composition developed at Siberian chemical plant is basically universal, allows recycling uranium concentrates with different content of impurities and obtaining uranium nitrate solutions corresponding by quality to the international standards requirements to uranium hexafluoride preparation for isotopes ASTM C 787-03 separation and to ceramic fuel ASTM C 788-02 preparation. Uranium reserves in Russia and abroad were appraised.

UDC 546.791.02.238:66.061.51.3/5

**Noskov M.D., Istomin A.D., Korotkevich V.M., Kozyrev A.S.,
Shikerun T.G., Shamin V.I., Mikhailova N.A., Romanov M.E.**
**PHYSICO-MATHEMATICAL MODEL OF URANIUM
CONCENTRATE EXTRACTION PROCESSING
IN COUNTERCURRENT COLUMNS CASCADE**

Program-technical complex intended for effectiveness increase and optimization of operating countercurrent columns cascade, achievement of the required process variables of output solutions at changing characteristics of initial solution has been developed. The model describes unbalanced noncommutated homogeneous and heterogeneous processes subject to a large number of components (uranium, nitric acid, iron, silicon, molybdenum, calcium etc.). On the basis of numerical implementation of mathematical model the problem oriented software allowing us to simulate extraction processing of uranium concentrates was developed.

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**Kozyrev A.S., Shikerun T.G., Ryabov A.S., Shamin V.I.,
Mikhailova N.A., Skuratova M.V.**
**INTENSIFYING SEPARATING PROCESSES
OF HIGH-CONCENTRATION URANYL SOLUTIONS
AND FINE-DISPERSED SUSPENDED SOLIDS**

The investigations on intensifying separation processes of high-concentration uranyl nitrate solutions and solid fine-dispersed suspended particles (ferric, silicon, molybdenum oxides and others) applying organic coagulants and flocculants have been carried out. It is shown that in the investigated regions of uranium concentrates 300...450 g/l, nitric acid 0,5...3,0 mole/l at optimal temperature of 30...50 °C for phases effective separation the introduction of 100...200 mg/l of coagulant FLOQUATTM FL 45 °C (or an analogue VPK-402) and 5...10 mg/l of flocculant of FLOPAMTM FO 4140 PWG type is enough.

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**Kozyrev A.S., Shikerun T.G., Ryabov A.S., Shamin V.I.,
Mikhailova N.A., Romanov M.E., Buynovskiy A.S., Makaseev Yu.N.**
**THE RESEARCH OF URANIUM MONOXIDE-OXIDE
DISSOLUTION PROCESS IN NITRIC ACID**

The kinetics of concentrates of uranium monoxide-oxide dissolution process by nitric acid solutions of 5...9 mole/l in the range of 11...90 °C has been studied. It is stated that initial nitric acid concentration increasing results in some uranium dissolution degree increasing only at the first process stage. Temperature increasing significantly raises uranium dissolution degree at the first stage as well. Uranium dissolution degree increases for all studied temperatures with increasing of the process period. The main feature of the studied process is that while dissolving uranium monoxide-oxide the behavior of iron, molybdenum, silicon additives is adequate to that of uranium. The equation of the reducing sphere describes the uranium leaching process from its nitric acid concentrates.

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**Korotkevich V.M., Lazarchuk V.V., Shikerun T.G.,
Shamin V.I., Mikhailova N.A., Dorda F.A.**
**EXTRACTION PROCESSING OF CONCENTRATED SOLUTIONS
OF URANYL NITRATE WITH HIGH IMPURITIES CONTENT**

Process flowsheet of recycling uranium concentrated solutions with its purification from insoluble impurities of iron, silicon, molybdenum, calcium oxides and hydroxides and soluble impurities with application of centrifugal extractors cascade has been developed and suggested for commercial introduction. The process was carried out at extractant (30 % tributyl phosphate in hydrocarbon diluent) saturation in extraction assembly lower than a limiting level (85...95 g/l) and in wash assembly – at limiting saturation (up to 120 g/l). As a result the waste uranium content in water-tail solutions 0,01...0,04 g/l and minimal content of impurities in re-extractors is provided.

UDC 622.374

**Andreev V.A., Buynovskiy A.S.,
Andreev A.A., Dyachenko A.N.**
**TOPAZ CONCENTRATE DESILICONIZATION
WITH AMMONIUM BIFLUORIDE**

Fluoridizing agent for the process of topaz concentrate desiliconization has been selected, topaz thermodynamic potentials have been appraised, thermodynamic probabilities of fluorination reaction of topaz concentrate main constituents have been calculated. The results of studying the concentrate desiliconization process with ammonium bifluoride by the methods of thermogravimetry, RFA, microphotography are presented.

UDC 661.488

**Andreev V.A., Buynovskiy A.S.,
Dyachenko A.N., Kraidenko R.I.**
**STUDYING THE UTILIZATION TECHNIQUES
OF AMMONIUM HEXAFLUOROSILICATE**

The utilization techniques of ammonium hexafluorosilicate have been proposed and studied. Thermodynamic calculations of equilibrium gas phase compositions of topaz concentrate fluoridation reaction and reaction of $(\text{NH}_4)_2\text{SiF}_6$ absorption by ammonium hydroxide were given. Experimental investigations in studying gas phase composition were carried out. The sublimation process of ammonium hexafluorosilicate as well as the process of its dissolving in ammonia water with silicon dioxide obtaining was studied.

UDC 546.161

Dyachenko A.N., Kraydenko R.I.
**SEPARATION OF SILICON-IRON-COPPER-NICKEL
CONCENTRATE BY FLUORAMMONIUM METHOD
INTO INDIVIDUAL OXIDES**

Processes of ammonium hydrodifluoride interaction with main components of copper-nickel concentrates – iron, copper, nickel oxides have been investigated. Thermodynamic of chemical reactions was calculated. Thermogravimetric analysis was carried out. The main kinetic parameters – activation energy and interaction rate constant of ammonium hydrodifluoride with iron, copper, nickel oxides were experimentally determined. Manufacturing sequence allowing us to single out individual oxides from oxide mixture was proposed.

UDC 661.48.546.16

Karelin V.A., Kameneva O.V.
**APPLICATION OF FLUORIDE SALT SYSTEMS FOR OBTAINING
TITANIUM BY THE METHOD OF ELECTROLYSIS**

Fundamentally new fluoride method of synthesis of high-clean metal titanium powder from natural oxide concentrates has been proposed. In a closing stage of processing the electrolytic method of titanium tetrafluoride decomposition in soft eutectic of alkali fluoride salts was used for the first time. Using this method in industrial practice

allows excluding environment contamination with hazardous chemical substances and obtaining cheap high-clean metal titanium powder.

UDC 66.011

Liventsova N.V.

OPTIMIZATION OF FLUORINE OBTAINING PROCESSING

Integrated efficiency functional of fluorine obtaining processing for determining optimal temperature and concentrate magnitudes by the method of multiparameter optimization has been developed. Analytic dependences of HF vapor pressure over the melt KF-HF, activation energy of specific conductivity and viscosity in operating range of controlled variable were obtained.

UDC 544.344

**Zherin I.I., Usov V.F., Ostvald R.V.,
Shagalov V.V., Gayday I.V., Tyulyubaev Z.M.**

**PHASE EQUILIBRIUM LIQUID-VAPOR
IN THREE-COMPONENT SYSTEM UF_6 - IF_5 - BrF_3
AT COMPLETE MUTUAL COMPONENTS SOLUBILITY**

The results of studying phase equilibrium liquid-vapor at 353,15 K in the system of uranium hexafluoride, iodine pentafluoride, bromine trifluoride have been presented. The dependences of saturated vapor pressure on condensed phase composition, the results of analysis of studied system deviation from error-free behavior, the data on equilibrium vapor phase are given.

UDC 669.28:54

Makarov F.V., Guzeev V.V., Guzeva T.I.

**PROTECTION OF MOLYBDENUM CONTAINERS USED AT
URANIUM DIOXIDE SINTERING FROM GRAIN BOUNDARY
DIFFUSION OF OXYGEN AND NITROGEN**

The results of investigating the reasons of damaging molybdenum containers used at energy tablets sintering from uranium dioxide have been given. The influence of niobium protective coating on changing molybdenum microstructure and properties is investigated. It is shown that protective coating prevents the formation of carbide, nitride and oxide phases on the boundary of molybdenum grains increasing thereby the durability.

UDC 66.011

Bereza V.N., Dyadik V.F., Baydali S.A.

**MATHEMATICAL MODEL OF A RECORD TYPE DEVICE FOR
VALUED COMPONENTS RECOVERY FROM END PROCESS
GASES OF URANIUM HEXAFLUORIDE PRODUCTION**

Mathematical model of the device for valued components recovery from end gases of sublimate production including hydrodynamic, thermodynamic and kinetic of interaction process of solid and gaseous phases realized in the package MATLAB has been presented. Static and dynamic characteristics of the device as a control object necessary for control algorithm synthesis are obtained and analyzed.

UDC 665.12.001.57

Kravtsov A.V., Usheva N.V., Moyzes O.E., Kuzmenko E.A.
**MATHEMATICAL SIMULATION OF WATER AND METHANOL
SEGREGATION PROCESSES AT FIELD PREPARATION OF GAS
CONDENSATE**

Calculation modulus for segregation processes of water and methanol from gas condensate has been developed. Applying the developed technological system the influence of process variables on segregation processes of water and methanol is studied. Modes of operation of liquid separators at which the most efficient segregation of water-methanol solution from unstable condensate occurs are recommended.

UDC 665.658.6:542.943'7:547.261:66.097.3

**Brenchugina M.V., Buynovskiy A.S.,
Ismagilov Z.R., Kuznetsov V.V.**

**THE DEVELOPMENT OF PURIFYING TECHNOLOGY OF
PROCESS WATERS OF GAS CONDENSATE FIELD FROM
METHANOL**

The possibility in principle of methanol deep catalytic oxidation in water up to MPC has been confirmed by gas chromatography method.

Oxidation process of methanol contained in cube residue after regeneration stage in concentrations of 1, 5 wt. % and less, at metal oxide catalysts at Al_2O_3 is considered. The basic flow diagram of closed technological cycle of methanol extraction from process waters of gas condensate fields is proposed. It consists in methanol regeneration with further deep catalytic oxidation of methanol residue quantity.

UDC 621.039:3;621.039.54-73

Sazonov R.V., Pushkarev A.I., Sosnovskiy S.A.
**INVESTIGATION OF ISOTOPIC COMPOSITION
OF PLASMACHEMICAL CONVERSION PRODUCTS
OF SULFUR HEXAFLUORIDE**

The results of investigation of sulfur hexafluoride decomposition in mixture with hydrogen and oxygen in plasma of pulsed electron beam formed by accelerator TEA-500 (350...500 kV, 60 ns, current density 0,3...0,4 kA/cm²) have been presented. The data of thermodynamic simulation of gas mixture SF_6+O_2 and $SF_6+H_2+O_2$ conversion in low-temperature plasma and gas mixture composition after electron beam influence measured by mass-spectrometer are given. It is shown that the formed gas-cycle compound synthesized in plasma of pulsed electron beam is sulfur difluoride-oxide. Isotope analysis of $(SOF)^+$ and $(SOF_2)^+$ ions is carried out. It is obtained that sulfur isotope ^{34}S content in sulfur difluoride-oxide exceeds its content in initial sulfur hexafluoride in $1,8 \pm 0,1$ times.

UDC 621.039.337

**Andrienko O.S., Egorov N.B., Zherin I.I., Indyk D.V.,
Tsepenko E.A., Dyachenko A.S.**
**MAGNESIUM ISOTOPES SELECTION
AT RECRYSTALLIZATION OF $MgCl_2 \cdot 6H_2O$**

The change of Mg isotope composition at grain-refined zone of $MgCl_2 \cdot 6H_2O$ has been studied. It is shown that light isotope ^{24}Mg enrichment occurs on that crystal end to which grain-refined zone is moving. Isotopes ^{25}Mg , ^{26}Mg are concentrated in the initial crystallization zone. Segregation coefficient increases at influence of constant magnetic field or direct electric current on molten zone. The obtained data are compared with the data on magnesium isotope segregation by the other physicochemical methods.

UDC 66.087.2+546.657

Grebnev V.A., Dmitrienko V.P.
OBTAINING NEODYMIUM FROM MELTS BY ELECTROLYSIS

The mechanism of electrode reactions at electrochemical obtaining neodymium and neodymium-iron alloy from fluoride oxide systems has been studied. Current-voltage dependences of electrochemical processes in melts containing fluorine salts of lithium, potassium, sodium and neodymium oxide were analyzed. Neodymium current yield values, optimal process variables: current density, temperature, melt composition were determined. Electrolyzers constructions were optimized, experimental-industrial electrolyzer was designed, process instrument flow diagram was developed.

UDC 669.871.5

Vidyaev D.G.
**PHASE REVERSAL ORGAIZATION
IN GALLIUM-EXCHANGE SYSTEMS**

Phase reversal stages at alkalis separation by chemical exchange method in LiGa-NaOH и LiGa-KOH systems have been studied. Pilot laboratory plants for intermittent and continuous obtaining lithium gallium in metal melts were developed and tested. The possibility of realization of alkalis multiple separation process by gallium-exchange method in packed column was shown.

UDC 666.965:541.182:621

Lotov V.A.
**NANODISPERSED SYSTEMS IN PROCESSING BUILDING
MATERIALS AND UNITS**

The examples of obtaining nanodispersed systems and materials have been given. It is shown that nanodispersed systems are formed at hydration of binders, clay minerals, immediate silica dissolution in soda,

different carbonates dissolution in carbonic acid etc. Control of nanodispersed system formation process and using materials obtained artificially in these processes is the main task of structural material science.

UDC 543.253

**Karbainov Yu.A., Puchkovskaya E.S., Karbainova S.N.
ADSORPTION OF AZITHROMYCIN DIHYDRATE
AT STATIONARY MERCURY AND SOLID ELECTRODE**

Adsorptive component in oxidation and renewal processes at different types of electrodes for antibiotic-macrolide azithromycin dihydrate has been studied. Adsorption parameters for azithromycin oxidation processes at glass-carbon electrode and for renewal processes at mercury-film electrode were calculated.

UDC 543.253

**Buynovskiy A.S., Kolpakova N.A., Melnikova I.A.
DETERMINING RHENIUM IN CRUDE ORE
BY THE METHOD OF X-RAY FLUORESCENCE ANALYSIS**

Optimal conditions of sorption concentration of perrhenate-ions with activated carbon have been considered. The possibility of rhenium determination with accompanying element is shown.

UDC 547.539.04

**Chaykovskiy V.K., Funk A.A.,
Martynyuk O.A., Filimonov V.D., Kets T.S.
INVESTIGATION OF PREPARATIVE POSSIBILITIES OF IODINATING SYSTEMS ON THE BASIS OF N-iodoacetamide**

N-iodoacetamide in organic solvents with H_2SO_4 iodinated successfully alkylbenzenes, aromatic amines and phenol ether. Electrophilic iodine activity is controlled by medium acidity. Super electrophilic iodine formed at N-iodoacetamide dissolution in sulfuric acid reacts easily with electron-deficient arenes at 0...20 °C forming iodinated products.

UDC 581.192+547.914

**Zhuk V.V., Yagovkin A.Yu., Bakibaev A.A.,
Yanovskiy V.A., Medvedev D.M.
STUDYING THE INFLUENCE OF EXTRACTANTS NATURE IN
THE PROCESS OF THIN-FILM VAPOR-PHASE EXTRACTION
ON COMPOSITION, DEGREE OF EXTRACTION AND FORM
OF OBTAINED PRODUCTS**

The technique of thin-film vaporphase extraction of vegetable raw material has been described. By the example of birch bark the efficiency of the technique for obtaining extractive substances especially of triterpeneoid nature is shown.

UDC 547.46'054.41/5

**Yanovskiy V.A., Baturin D.M., Yagovkin A.Yu., Bakibaev A.A.
REDUCTION OF SOME CYCLIC DERIVATIVES OF DIPHENIC
ACID WITH SODIUM BORANE IN ALCOHOLS**

Reduction of heptamers cyclic imides with sodium borane has been carried out for the first time by the example of some imides of diphenic acid. In this case for the first time amides of 2'-hydroxymethylxeny-2-carboxylic acid which are potentially valued bioactive compounds were obtained. It was shown that the nature of substituent at nitrogen atom influences the reaction products yields and composition. The reduction of diphenic acid anhydride with sodium borane in simple alcohols occurs with the formation of reduction products – 7H-dibenzyl[c,e] oxepin-5-on (36...46 %) as well as products of diphenic acid alcoholysis-monoester (29...36 %). In this case the nature of alcohol influences weakly on reaction products ratio.

UDC 678.761.002.2

**Bondaletov V.G., Manankova A.A., Bondaletova L.I.,
Vishnevskaya A.L., Ogorodnikov V.D.
STUDYING CYCLOPENTADIENE DIMERIZATION**

**IN COMPOSITION OF FRACTIONS OF PYROLYSIS LIQUID
PRODUCTS BY MEANS OF NMR ¹H-SPECTROSCOPY**

Dimerisation process in composition of fractions of cyclopentadiene pyrolysis liquid products – the most reactive component has been considered. With the help of NMR ¹H-spectroscopy current concentrations of monomer and dimer are measured and velocity constants of demerisation are calculated.

UDC 678.761.002.2

**Bondaletova L.I., Bondaletov V.G.,
Verevkin O.V., Manankova A.A.
DETERMINING STRUCTURE OF PETROLIUM POLYMER
RESINS OBTAINED ON THE BASIS OF HIGH-BOILING
FRACTIONS OF PYROLYSIS LIQUID PRODUCTS**

On the basis of experimental spectra and spectra calculated with the help of ACDLabs (HNMR) NMR ¹H program the structure of petroleum polymer resins obtained by polymerization of high-boiling fractions of pyrolysis liquid products has been specified. Close fit between calculated and experimental results is obtained.

UDC 541:537.523:66.011

**Kudryashov S.V., Ryabov A.Yu.,
Shegoleva G.S., Sirotkina E.E., Suslov A.I.
OXIDATION OF H-C5-C8 HYDROCARBONS AND CYCLO-
HEXANE IN A REACTOR WITH BARRIER DISCHARGE. P. 2.
SIMULATING CYCLOHEXANE OXIDATION REACTION**

Numerical model of hydrocarbon oxidation kinetics in a reactor with barrier discharge has been proposed by the example of cyclohexane oxidation reaction. The results of calculations with the use of barrier discharge surface model showed that electron energy and other discharge characteristics in pure oxygen and in the mixture of oxygen with cyclohexane vapors slightly differ that allowed using a simplified model of homogeneous discharge for simulating cyclohexane oxidation reaction. The results of calculation showed good fit with the experimental data.

UDC 504.064:66.094.3.001.63

**Kukurina O.S., Novikov V.T., Shtykina A.V.
THE DEVELOPMENT OF LIQUID-PHASE METHOD
FOR PHENOL DEEP OXIDATION**

The reaction of deep oxidation of toxic organic compounds-phenol and its nitro- and chloroderivatives in oxidizing medium electrochemically generated in situ has been studied. Kinetic parameters of the process and oxidation end products are determined. Standard method of determining a demand of chemical oxygen in a sample is suggested as an analytical testing method of phenol decomposition.

UDC 541.64:547.759.32

**Lyapkov A.A., Sutyagin V.M.
LAWS OF KATIONIC POLYMERIZATION OF 9-VINILCAR-
BAZOLE UNDER THE INFLUENCE OF TRITILLIUM SALTS**

Kinetic laws of cationic polymerization of 9-vinylcarbazole under the influence of $Ph_3C+Al(C_2H_5)_2Cl_2$ – in a solution $CHCl_3$ at 20 °C have been studied. Kinetic of the process is studied by setting the stopped flow method with recording in IR region. The behavior of the studied system corresponds to the model of "quasi-alive" polymerization. It is supposed that the most probable type of active particles is solvate separated ion pairs. The efficient value of circuit growth constant is calculated.

UDC 547.759.32+678.02

**Rovkina N.M., Batyrova L.M., Izergina N.V., Vatyuk E.I.
POLYMERIZATION OF 9-ALLYL CARBAZOLE,
EPOXYKARBAZOLYPROPANE AND KARBAZOLYLTIRAN**

The ability to 9-allylcarbazole polymerization both with radical type activators and ion catalysts has been shown. The conditions were found and polymerization techniques of 9-allylcarbazole, 9-karbazolyltiran and 9-epoxykarbazolypropene were suggested.